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WOODY VEGETATION DIVERSITY OF LONGLEAF PINE COMMUNITIES IN CALCASIEU PARISH, LOUISIANA

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ABSTRACT

Located in southwestern Louisiana, Calcasieu Parish once supported large areas of undisturbed longleaf pinelands. These pinelands were clear cut around 1900 and have been converted largely to forest, range, and cropland. Although virgin longleaf pinelands no longer exist in the Parish, a few remnant sites retain many of their presettlement plant species and characteristics. Three distinctly different longleaf pine communities were identified and sampled to determine woody species diversity and importance. Diversity values of the three communities differed significantly from each other. The acid longleaf pine flatwoods community was less diverse than either the hillside seepage bog community or the sodic longleaf pine flatwoods community. The low diversity value for the acid longleaf pine flatwoods community was due primarily to low species richness when compared to the other two communities. Although the hillside seepage bog and the sodic longleaf pine flatwoods each had identical species richness values, the disparity in their diversity values is explained primarily by the greater evenness of species abundance at the sodic longleaf pine flatwoods community. The various mixtures of woody species sampled suggest a high degree of heterogeneity among the sites chosen for study. For example, of the eleven different species found among the three communities, only *Pinus palustris* was present at all three. *Pinus palustris* was the most important in all but the sodic longleaf pine flatwoods community where it was second to *P. elliottii*. The importance value for all combined communities was clearly dominated by *P. palustris* at 140.69. *Pinus elliottii* had the second highest importance value for all combined communities at 62.83 with *Myrica cerifera* third at 31.58. Relative coverage for all communities combined was also dominated by *P. palustris* at 55.82% with *P. elliottii* and *M. cerifera* at 31.73% and 6.56% respectively.

KEY WORDS: Calcasieu Parish, Louisiana, longleaf pine communities, woodland remnants

The longleaf pineland region of the West Gulf Coastal Plain (Bridges & Orzell 1989) extends across northern Calcasieu Parish (Figure 1). This region originally extended from southeastern Texas to north-central Louisiana (Wahlenberg 1946; Little 1971). These pinelands were clear cut in the early 1900's (Roy & Midkiff 1988; Smith 1991) and now exist primarily as forest, range and cropland (Roy & Midkiff 1988). Remnant longleaf pine communities of the West Gulf Coastal Plain identified by Orzell (1987) and Bridges (1988) are currently threatened by grazing, silvaculture, and wildlife management (Bridges & Orzell 1989). The once virgin longleaf pinelands as described by Schwarz (1907) and Wahlenberg (1946) are now rare in Louisiana (Smith 1991). However, a few comparatively undisturbed sites within Calcasieu Parish appear to retain many of their presettlement plant species and remain recognizable longleaf pine communities (*sensu* Bridges & Orzell 1989; Smith 1991, 1996). These rare sites are small and may be considered remnants of a once dominant ecosystem.

The purpose of this study is to characterize the adult woody vegetation of three remnant longleaf pine communities in Calcasieu Parish in terms of density, frequency coverage, and importance. These communities are referred to as hillside seepage bogs, sodic longleaf pine flatwoods (sodic flatwoods), and acid longleaf pine flatwoods (acidic flatwoods). This terminology is *sensu* Smith (1996).

STUDY AREA

Located in southwestern Louisiana, Calcasieu Parish is adjacent to Beauregard Parish to the north, Jefferson Davis Parish to the east, Cameron Parish to the south, and the State of Texas to the west (Figure 1). Approximately 46% of the Parish's land is devoted to either agriculture or rangeland; approximately 23% is woodland; 11% is marsh; 4% swamp; and the remaining area is urban (Roy & Midkiff 1988). Land use is devoted primarily to timber, cattle, rice, and soybeans. Petroleum-related industries are present in the Parish and are concentrated around the area of Westlake. Calcasieu Parish is noteworthy for the abrupt transition from the longleaf pinelands in the north to the prairie and coastal marshes in the south (Figure 1).

The first study site is a hillside seepage bog situated about 8 km northeast of DeQuincy; (93° 23′ 83″ × 30° 28′ 92″); range and township (R10W × T7S Sect. 1) (Figure 1). This is the only known representative of this community type in the Parish. The site extends approximately 600 m on a north-south-axis by 36 m on an east-west axis and is bounded to the west by a semi-evergreen broadleaf acid seep forest (*sensu* Bridges & Orzell 1989), and to the east by a stand of *Pinus elliottii* Engelm. This bog appears to be the headwaters of a small unnamed stream. The soil type is "Glenmora silt loam" (Roy & Midkiff 1988) and is characterized by an extremely acidic silt loam surface layer and a strongly acid silty clay loam subsoil. Distinctive herbaceous species include *Rhynchospora oligantha* A. Gray, *Sarracenia alata* (Wood) Wood, and *Utricularia cornuta* Michx. Charred bases of *P. palustris* Mill. indicate the site had burned within the past several years.

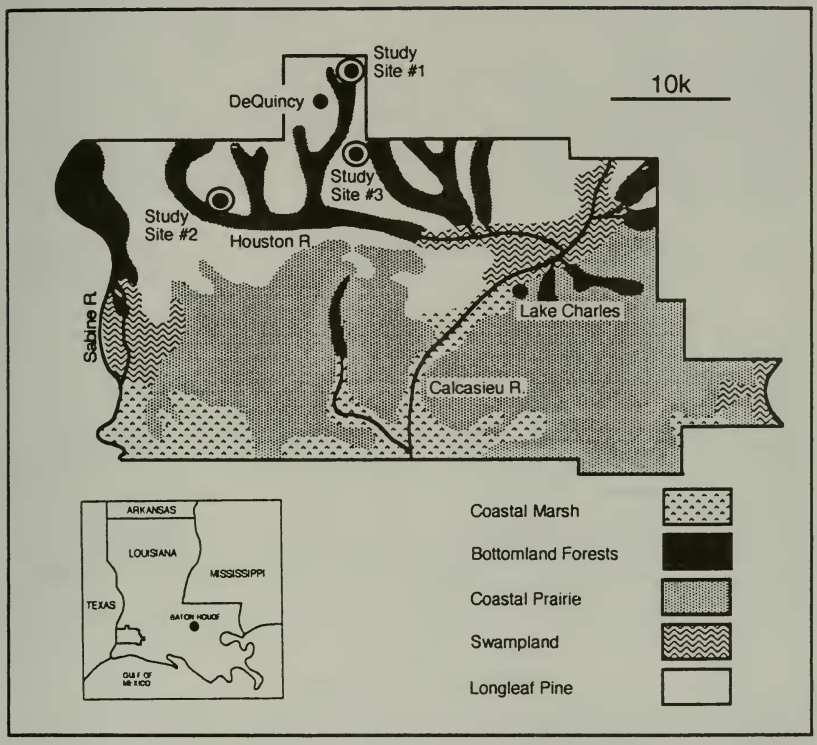

Figure 1. Area of longleaf pineland in relation to other regions within Calcasieu Parish, Louisiana. Inset shows the location of the Parish within the State. Study site #1 = hillside seepage bog; #2 = sodic flatwoods; #3 = acidic flatwoods.

The second study site is a sodic flatwoods that is situated near a few other similar sites in the western part of Calcasieu's longleaf pineland region (Figure 1). These flatwoods are typically saturated during the winter and spring but may become very dry during summer droughts. The specific site studied is situated about 22 km southwest of DeQuincy; (93° 34′ 15″ × 30° 18′ 74″); range and township (R11W × T8S Sect. 35) (Figure 1). It is bounded to the south by the Houston River and to the west by Creek Road. The community is approximately 2.5 km long on its east-west axis and 2.0 km long on its north-south axis. Distinctive herbaceous species include *Spartina spartinae* (Trin.) Hitch., *Chaetopappa asteroides* (Nutt.) DC., *Evolvulus sericeus* Sw., and *Liatris punctata* Hook. The understory woody vegetation is stunted. The soil type is "Brimstone" and has a very strongly acidic silt loam layer, a subsurface that is medium acid silt loam, and a subsoil of alkaline silty clay that is high in sodium (Roy & Midkiff 1988).

The third study site is an acidic flatwoods and is situated in the central part of the longleaf pineland region, about 10 km southeast of DeQuincy; (93° 20′ 85″ × 30° 22′ 63″); range and township (R9W × T7S Sect. 11) (Figure 1). This acidic flatwoods extends about 1.2 km on its north-south axis and about 0.4 km on its east-west axis and is bounded on the east by Holbrook Park Rd. and to the west by cleared land. The soil type is "Caddo-Messer silt loam" and has a very strongly acidic surface and subsurface layer (Roy & Midkiff 1988). The subsoil is strongly acid silty clay loam or silt loam. The terrain is level to gently rolling with small elevated areas termed "pimple mounds" by Holland *et al.* (1952). Under natural conditions and frequent fires, these flatwoods support a sparse canopy of longleaf pine with few other tree species (Bridges & Orzell 1989). The planting of pine plantations and fire suppression have nearly eliminated these communities in the Parish. Distinctive herbaceous species in this community include *Stylisma aquatica* (Walter) Raf. and *Platanthera nivea* (Nutt.) Luer. To our knowledge, this is the only acidic flatwoods community in Calcasieu Parish that supports a rich herbaceous layer.

MATERIALS AND METHODS

The three representative community types chosen for this study share the following characteristics: 1) longleaf pine is a major component; 2) community maintenance requires frequent fires; 3) herbaceous ground cover is species rich. Each site was selected to represent one of the three longleaf pine communities in Calcasieu Parish that shares these criteria. Although these sites are not pristine, we consider them recognizable longleaf pine communities (*sensu* Bridges & Orzell 1989; Smith 1991, 1996).

Each sampled area measured 100 m along its long axis and 36 m on its short axis. Data were collected on tree and shrub species (vines were excluded) with a diameter at breast height (DBH); (1.3 m) of 1 cm or greater. Randomly selected ten by ten meter quadrats (plots) were used for sampling within the defined study sites. Plot size was based on that recommended for forest trees by Cox (1996) and Brower *et al.* (1998).

The number of plots sampled per site was determined by constructing a species area curve to ensure we encountered the bulk of species present (Cox 1996). Specifically, a plot of cumulative number of species encountered versus cumulative number of plots sampled indicated fifteen plots was adequate to sample nearly all of the species present. Sampling for hillside seepage bog, sodic flatwoods and acid flatwoods sites were performed on April 8, May 3, and May 20, 1998 respectively. Nomenclature follows Kartesz (1994).

Frequency, density, coverage (basal area) and importance values were calculated to determine the dominant woody species (Cox 1996). Basal area was estimated from DBH values. The importance value is equal to the sum of relative frequency, relative density, and relative coverage. These values were calculated for each of the three sites individually and for all sites combined. Species diversity was calculated using Simpson's Diversity Index (Cox 1996) and was calculated from density data. Because we consider the few small "pimple mounds" to be "intrusions" into the acidic flatwoods site, woody species were excluded from sampling. However, a complete inventory of the woody species inhabiting these mounds was made and is included in the following section.

RESULTS

Species area curves (Cox 1996) suggest that fifteen samples were sufficient to encounter the bulk of species present at each site. That is, the final plot number for each site was positioned well into the asymptotic portion of the curve.

Woody vegetation diversity values among the communities differed significantly ($p < 0.05$) (Table 1). The low diversity value for the acidic flatwoods site was due primarily to low species richness as compared to the other two communities. Although the hillside seepage bog and the sodic flatwoods site each had identical species richness values (Table 1), the disparity in diversity values is explained primarily by greater evenness of species abundance at the sodic flatwoods.

Density, frequency, coverage, and importance values for all sites are summarized in Table 2. The various mixtures of woody species sampled suggest a high degree of heterogeneity among the three sites. Of the eleven different species discovered among the sites, only *Pinus palustris* was present in all three. *Myrica cerifera* L. was present in all three communities but no individuals met our size criterion for sampling in the acidic flatwoods due to a recent burn. Additionally, seven species were present in only one of the three sites: *P. elliottii*, *Ilex vomitoria* Aiton, *Quercus marilandica* Muench, *Viburnum dentatum* L., *I. coriacea* (Pursh) Chapm., *Liquidambar styraciflua* L., and *Sapium sebiferum* (L.) Roxb. (Table 2). Heterogeneity among the communities is also demonstrated by the importance values of *P. palustris*. That is, although *P. palustris* was the most important species for all communities combined (Table 3), it was only the second most important species in the sodic flatwoods site (Table 2).

Table 1. Simpson's Diversity Index, variance, and species richness of woody vegetation by study site.

Site	Index (D_S)	Variance (S^2)	Species Richness
Hillside Bog	0.495	.0019	6
Sodic Flatwoods	0.611	.0008	6
Acid Flatwoods	0.165	.0067	3

Table 2. Density, frequency, coverage and importance values by species by individual site. Species are arranged in order of importance.

Species	Density (#/plot)	Relative density	Frequency	Relative Frequency	Coverage (cm^2/plot)	Relative coverage	Importance Value
Hillside Bog							
Pinus palustris	4.13	63.83	0.73	31.33	489.87	85.56	180.72
Ilex coriacea	0.73	11.28	0.53	22.75	30.36	5.25	39.28
Nyssa biflora	0.73	11.28	0.40	17.17	33.52	5.85	34.30
Myrica cerifera	0.67	10.36	0.47	20.17	17.11	2.99	33.52
Liquidambar styraciflua	0.13	2.00	0.13	5.58	1.76	0.31	7.89
Sapium sebiferum	0.07	1.08	0.07	3.00	0.21	0.04	4.12
Sodic Flatwoods							
Pinus elliottii	2.93	38.91	0.67	29.65	679.66	48.12	116.68
Pinus palustris	2.47	32.80	0.33	14.60	547.22	38.75	86.15
Ilex vomitoria	0.87	11.55	0.60	26.55	44.22	3.15	41.25
Myrica cerifera	0.93	12.35	0.33	14.60	128.92	9.13	36.08
Quercus marilandica	0.20	2.66	0.20	8.85	5.59	0.40	11.91
Viburnum dentatum	0.13	1.73	0.13	5.75	6.53	0.46	7.94
Acid Flatwoods							
Pinus palustris	1.27	90.07	0.80	85.11	158.37	99.17	274.35
Sassafras albidum	0.07	4.96	0.07	7.45	1.26	0.79	13.20
Nyssa biflora	0.07	4.96	0.07	7.45	0.06	0.004	12.41

Table 3. Density, frequency, coverage, and importance values by species summarized for all sites. Species are arranged in order of importance.

Species	Density (#/plot)	Relative Density	Frequency	Relative Frequency	Coverage (cm^2/plot)	Relative Coverage	Importance Value
Pinus palustris	2.62	51.17	0.62	33.70	398.49	55.82	140.69
Pinus elliottii	0.98	19.14	0.22	11.96	226.55	31.73	62.83
Myrica cerifera	0.53	10.35	0.27	14.67	46.82	6.56	31.58
Ilex vomitoria	0.29	5.66	0.20	10.87	14.81	2.07	18.05
Ilex coriacea	0.24	4.69	0.18	9.78	10.91	1.53	16.00
Nyssa biflora	0.27	5.27	0.16	8.70	11.19	1.57	15.54
Quercus marilandica	0.07	1.37	0.07	3.80	1.86	0.26	5.43
Viburnum dentatum	0.04	0.78	0.04	2.17	2.18	0.31	3.26
Liquidambar styraciflua	0.04	0.78	0.04	2.17	0.59	0.08	3.03
Sassafras albidum	0.02	0.39	0.02	1.09	0.42	0.06	1.54
Sapium sebiferum	0.02	0.39	0.02	1.09	0.07	0.01	1.49

Importance for all combined communities was dominated by *Pinus palustris* at 140.69 (Table 3). *Pinus palustris* was the most important in all but the sodic flatwoods community where it was second to *P. elliottii* (Table 3). *Pinus elliottii* had the second highest importance value for all combined communities at 62.83 with *Myrica cerifera* third at 31.58 (Table 3). Relative coverage for all communities combined was dominated by *P. palustris* at 55.82% and *P. elliottii* at 31.73% (Table 3).

Woody species that occurred in quadrats of the hillside seepage bog but did not meet the minimum size requirements for sampling included *Acer rubrum* L., *Aronia arbutifolia* (L.) Elliott, *Hypericum brachyphyllum* (Spach) Steud., and *Magnolia virginiana* L. Because neither *Acer rubrum* nor *M. virginiana* had sufficient time for regrowth since a recent burn, no individuals met our criterion for sampling. Additionally, these two species are rare in this particular community. Although *H. brachyphyllum* and *Aronia arbutifolia* are common at this site, both are small shrubs and no individuals met our sampling criterion. The woody vine, *Smilax laurifolia* L., was also present.

Rare individuals of *Magnolia grandiflora* L. were observed in the sodic flatwoods site but were not included in any sampled quadrats. Although the woody shrub *Ilex opaca* Aiton was common in the site, no individuals met our size requirements for sampling. Woody vines present included *Smilax smallii* Morong and *Berchemia scandens* (Hill) K. Koch.

Woody species that occurred in the acidic flatwoods quadrats but did not meet the minimum size requirements for sampling included *Baccharis halimifolia* L., *Sapium sebiferum*, and *Myrica cerifera*. Because of a controlled burn in the fall of 1996, no individuals of these three species were sufficiently large enough to meet the sampling

criterion. Of these three species encountered, only *M. cerifera* appeared to be common on the site. The woody vine, *Smilax laurifolia*, was also present.

A complete inventory of the woody species inhabiting the pimple mounds within the acidic flatwoods community includes *Sapium sebiferum*, *Acer rubrum*, *Myrica cerifera*, *Sassafras albidum* (Nutt.) Nees, *Quercus falcata* Michx., *Q. nigra* L., *Ilex opaca*, and *Liquidambar styraciflua*.

DISCUSSION

Although not pristine, the three remnant sites analyzed in this study resemble longleaf pine communities before settlement and clear cutting. However, the current state of these pinelands is undoubtedly different from the time prior to settlement. For example, the most important species found in the sodic flatwoods site, *Pinus elliottii*, is native only in Louisiana parishes east of the Mississippi River (Flora of North America Committee 1993) and, therefore, would have been absent in presettlement times. Although this commercially introduced species historically has been used for its naval stores, *P. elliottii* has become an increasingly important plantation pine for lumber and plywood (Flora of North America Committee 1993). The establishment of *P. elliottii* has almost certainly displaced other native woody species.

Steps have recently been taken to preserve at least a part of the sodic flatwoods in Calcasieu Parish. The Nature Conservancy of Louisiana has recently purchased approximately 240 contiguous acres of sodic flatwoods along Persimmon Gully that are adjacent to study site number two (Richard Martin, pers. comm., 1998).

The acid flatwoods and hillside seepage bog sites support a few individuals of the introduced *Sapium sebiferum*. This native of subtropical China, commonly called Chinese tallow, has been planted in several areas of the world as an ornamental and for the production of vegetable tallow and stillingia oil from its fruits (Kahn *et al.* 1973). This species was introduced to the Southeast by the U.S.D.A. Bureau of Plant Industry in the early 1900's to establish local soap industries (Jamieson & McKinney 1938). The ability of *Sapium* to aggressively invade and quickly alter habitat is well documented (Cameron & Spencer 1989; Bruce *et al.* 1995; Neyland & Meyer 1997). At present, the incidence of *Sapium* at these two sites is low. However, it remains an open question to what extent this species will alter the ecology of these communities. Additionally, species composition in the hillside seepage bog has been altered since settlement times by the introduced *Pinus elliottii*. Specifically, all but the lowermost 36 m of the hillside seepage bog now supports a dense stand of *P. elliottii*.

The future of these remnant longleaf pine communities in Calcasieu Parish is uncertain. Most remain threatened by urbanization, wildlife management practices, and silvaculture. Without active protection, these rare communities may be destined for extinction in Calcasieu Parish.

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